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Greenhouse as well as roof element for such a greenhouse having increased light transmission

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BACKGROUND OF THE INVENTION

The invention relates to a greenhouse having a transparent roof construction with a longitudinal direction and a transverse direction located perpendicularly thereto, having various pairs of first roof surfaces in succession in the transverse direction, the first roof surfaces of a predetermined pair running at an angle with respect to a horizontal from a base edge oriented in the longitudinal direction of the greenhouse to a common apex. The invention also relates to a roof element for use in such a greenhouse.

It is known from the publication entitled "Second International Symposium on Models for Plant Growth", Environmental Control and Farm Management in Protected Cultivation, number 456, March 1998, to provide horticultural greenhouses with roof surfaces in succession in the transverse direction which run in the shape of a point towards an apex. For angles to the horizontal of greater than 45° the light transmission for radiation which is incident perpendicularly on the greenhouse is found to increase substantially. This is particularly important in horticultural greenhouses since one per cent more light yield results in approximately one per cent more yield of crops.

SUMMARY OF THE INVENTION

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An aim of the present invention is to provide a roof construction of the above-mentioned type, provided with a quantity of pairs of roof surfaces which are laid in contact with one another and come together in an apex, the light transmission being increased.

To this end the roof construction according to the present invention is characterised in that the greenhouse is also provided with pairs of successive second roof surfaces in the longitudinal direction, which second roof surfaces run at an angle with respect to the horizontal from a base edge oriented in the transverse direction of the greenhouse to a common apex.

It has been found that a zigzag or ribbed pattern of the roof surfaces extending in two perpendicular directions is able to increase the light yield by 10%-20% compared with roof constructions which are of zigzag construction only in the transverse direction. In a first embodiment the pairs of roof surfaces form pyramids which are joined to one another along their sides to give a continuous roof construction.

In another embodiment of a greenhouse according to the invention the pairs of first roof surfaces are in contact with one another along edges at the apex, wherein base edges and the edges at the apex of the pairs of first roof surfaces extend parallel to one another in

the longitudinal direction, wherein the pairs of second roof surfaces are in contact with one another along edges at the apex and wherein the base edges and the edges at the apex of the second pairs of roof surfaces extend parallel to one another from a base edge of a first roof surface to the edge at the apex of the first roof surface concerned. By this means successive transverse ribs are formed in the longitudinal direction of the greenhouse.

It is preferable to construct roof elements with a zigzag pattern double-walled as a hollow-core sheet so that, on the one hand, adequate strength and insulating effect of the roof construction is obtained whilst, on the other hand, the light transmission is increased. The double-walled roof elements comprise a base surface made of, for example, polycarbonate with a thickness of 0.8 mm on which a zigzag-shaped sheet with ribs approximately 20 mm high is fixed. Preferably, the double-walled roof element is made in one piece. The roof elements can be of modular construction and are provided with coupling means for joining to similar roof elements.

BRIEF DESCRIPTION OF THE DRAWINGS

A greenhouse according to the present invention and a roof element will be explained in more detail below with reference to the appended drawing. In the drawing:

Figure 1 shows a diagrammatic, perspective view of a roof with a roof construction that is in zigzag form in the transverse direction and the longitudinal direction,

Figure 2 shows a diagrammatic, perspective view of a roof construction formed from a series of pyramids,

Figure 3 shows a cross-section of a double-walled roof element in the form of a hollow-core sheet according to the present invention,

Figure 4 shows an alternative embodiment of a double-walled roof element in the form of a hollow-core sheet according to the invention,

Figure 5 shows a double-walled roof element formed by a series of pyramids, and

Figure 6 shows two roof elements joined to one another by means of coupling means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a greenhouse 1, such as, for example, a greenhouse of the Venlo type having a transparent roof construction 2. The roof construction 2 is supported on uprights 3 and horizontal lattice girders 4, which are shown here diagrammatically only. The height a of a greenhouse as shown in Figure 1 is, for example, 4 m, whilst the width, d_1 in the transverse direction D, is 8 m for a length in the longitudinal direction L of, for example, 100 m. The roof construction 2 comprises pairs of first roof surfaces 5, 6; 7, 8, which run from a base edge 11, 11', 11" at an angle θ of approximately 20° with respect to the horizontal and which are fixed to one another along a respective apex 9, 10. The height h_1

of the apex 9, 10 above the lattice girder 4 is, for example, 1.45 m. In the longitudinal direction L the pairs of roof surfaces 5, 6; 7, 8 are provided with transverse ribs, formed by pairs of second roof surfaces 12, 13; 14, 15. The roof surfaces 12, 13; 14, 15 run at an angle γ from base edges 18, 19; 20, 21 and are joined to one another along edges at the apex 16, 17. The distance d_2 between the base edges 18, 19; 20, 21 of the pairs of second roof surfaces 12, 13; 14, 15 is, for example, 2 cm, whilst the height h_2 of the edge at the apex 16, 17 above the plane of the base edges 18, 19; 20, 21 is 1.7 cm. As a result of fitting the pairs of zigzag-shaped second roof surfaces 12, 13; 14, 15 the light yield is increased by approximately 10% for a single layer roof construction and by approximately 20% for a double layer roof construction as is shown in Figure 3 and Figure 4, compared with known greenhouses where only pairs of first roof surfaces 5, 6; 7, 8 are present.

Figure 2 shows an embodiment of a greenhouse 28 having a roof construction 29 in which the base edges 30, 31, 32, 33 of pairs of first roof surfaces 34, 35 and pairs of second roof surfaces 36, 37 delimit rectangles in contact with one another, above which the roof surfaces 34, 35; 36, 37 come together in an apex 38, so that a multiplicity of pyramids 39, 40 is formed to increase the light yield. Here the length of the base edges 31, 32 is approximately 1 m, whilst the height of the pyramids is 1.7 m.

Figure 3 shows an embodiment of a double-walled roof element 50 in the form of a hollow-core sheet having a base sheet 51 and pairs of roof surfaces 52, 53, 54, 55 which are joined to one another along edges at the apex 56, 57 extending perpendicularly to the plane of the drawing. The base edges 60, 61, 62, 63 are joined via partitions 58, 59 to the base sheet 1: The thickness b_1 of the base sheet is, for example, 0.8 mm, the thickness b_2 of the surfaces 52, 53, 54, 55 is, for example, 1 mm, the height h_3 is, for example, 28 mm, whilst the distance d_3 between the base edges 60, 61, 62, 65 is, for example, 16 mm. The height h_5 is 13.9 mm.

The angle θ of the roof surfaces 52, 53, 54, 55 to the horizontal is 60°. The material of the double-walled roof element 50 is, for example, polycarbonate, but this element can also be made from any other suitable transparent plastic.

Figure 4 shows an alternative embodiment of a double-walled roof element 70 having roof surfaces 71, 72, which are positioned at an angle, and base surfaces 73, 74, which are likewise positioned at an angle and which are joined to one another by partitions 75, 76, 77. The thickness b_3 of the roof surfaces 71, 72 is, for example, 1 mm, the distance h_4 between the roof surfaces 71, 72 and the base surfaces 73, 74 is, for example, 20 mm and

the thickness b_4 of the partition 77 is, for example, 0.8 mm. The distance d_4 between the base edges 78, 79 is, for example, 30 mm.

Figure 5 shows an embodiment of a roof element 80 made from one piece of transparent plastic and having a base sheet 81. Four surfaces 82, 83, 84, 85 extend along four base edges 86, 87, 88, 89 of the base sheet 81 to a common apex 90. In this way a multiplicity of pyramids uniformly distributed over the base sheet 81 are formed. Here the length of the base edges 86, 87, 88, 89 is, for example, 1.5 m and the distance from the apex 90 to the base sheet 81 is 2.6 m.

Finally, Figure 6 shows two roof elements 90, 91 which are joined to one another via complementary fixing means 92, 93 which engage in a simple manner and in modular fashion form a roof construction according to the present invention.